SN 10/715,733
Docket No. S-102,311
In Response to Office Action dated December 14, 2005

REMARKS

The Office Action has been carefully reviewed. Reconsideration and allowance of the claims in light of the present remarks is respectfully requested. A petition and fee for a three-month extension of time accompanies this response.

Applicants initially wish to thank the Examiner for the courtesies extended during an interview held on March 6, 2006 with the undersigned attorney. While no final agreement was reached, the substance of the interview involved discussions on the term amphiphilic polymer and the prior art. Applicants further discussed the unexpected results that had been achieved by the subject matter of presently claimed invention, such results noted in recent journal publications. An interview summary sheet was provided by the Office and is consistent with this summary.

Claims 1-9, 17-23 and 25 stand rejected under 35 U.S.C. 102(b) as being anticipated by US Patent Application Publication 2002/011080 (Barney hereinafter). The Office Action stated that Barney teaches colloidal nanocrystals, a solid composite including nanocrystals and a process of making a solid composite including nanocrystals comprising mixing nanocrystals - including ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgS, HgSe, HgTe, AlN, AlP, AlAs, AlSb, GaN, GaP, GaAs, GaSb, InN, InP, InAs, InSb, TlN, TlP, TlAs, TlSb, PbS, PbSe and PbTe nanocrystals (¶¶ 0011 and 0022) - with an amphiphilic material - including alkyl phosphines, alkyl phosphine oxides, alkyl phosphonic acids, or alkyl phosphonic acids such as tri-n-octyl phosphine and tri-n-octyl phosphine oxide (¶ 0022) or poly(lauryl methacrylate) (¶ 0015) - and a sol-gel precursor-such as silicon alkoxide, titanium alkoxide or zirconium alkoxide (¶ 0031) - and forming a solid matrix containing the nanocrystals (¶ 0031) at ratios of 5:1 to 10:1 of the nanocrystal solution to the binder (¶ 0042) such that the resulting composition has upwards of 80% high emission quantum efficiency (¶0018).

Applicants respectfully submit that, with respect to claims 1-9, Barney fails to teach "admixing colloidal nanocrystals with an amphiphilic polymer including both hydrophobic groups and hydrophilic groups within a solvent to form an alcohol-soluble colloidal nanocrystal-polymer complex". Nothing in paragraph 22 of Barney teaches or describes such an amphiphilic polymer or mixing of such an amphiphilic polymer with colloidal nanocrystals to form an alcohol-soluble colloidal nanocrystal-polymer complex.

While the poly(lauryl methacrylate) mentioned in paragraph 15 of Barney might be arguably considered an amphiphilic polymer, the poly(lauryl methacrylate) is present only as a matrix material for conventional nanocrystals, i.e., ZnS-capped CdSe nanocrystals. This is in contrast to the subject matter of claims 1-9 wherein "an alcohol-soluble colloidal nanocrystal-polymer complex is formed from admixing colloidal nanocrystals with an amphiphilic polymer", followed subsequently by "admixing the alcohol-soluble colloidal nanocrystal-polymer complex and a sol-gel precursor material" to ultimately form a solid composite utilizing the sol-gel precursor material as the matrix material. Further, Applicants point out that with respect to claim 3, Barney fails to teach or describe an amphiphilic polymer including both hydrophobic groups and hydrophilic groups "where the hydrophilic groups are selected from the group consisting of -COOH, -OH, $-SO_3H$, $-NH_2$, and $-PO_3H_2$". Still further, Applicants point out that with respect to claim 9, Barney fails to teach or describe an amphiphilic polymer that is a "modified poly(acrylic acid) or modified poly(methacrylic acid), said modified poly(acrylic acid) or modified poly(methacrylic acid) including hydrophobic regions".

Applicants respectfully submit that, with respect to claims 17-23 and 25, Barney fails to teach a "solid composite comprising the reaction product of (i) colloidal nanocrystals complexed with an amphiphilic polymer including both hydrophobic groups and hydrophilic groups and (ii) a sol-gel precursor material". Barney fails to teach or describe the complexation of an amphiphilic polymer with colloidal nanocrystals. Rather Barney simply teaches or described poly(lauryl methacrylate) as a matrix material for conventional nanocrystals, i.e., ZnS-capped CdSe nanocrystals. Claim 17 specifically calls for a complex between colloidal nanocrystals and an amphiphilic polymer and claim 17 includes a "sol-gel precursor material" that serves as the matrix material for complex nanocrystals in the ultimate reaction product of the claim. Further, Applicants point out that with respect to claim 19, Barney fails to teach or describe an amphiphilic polymer including both hydrophobic groups and hydrophilic groups "where the hydrophilic groups are selected from the group consisting of -COOH, -OH, $-SO_3H$, $-NH_2$, and $-PO_3H_2$". Still further, Applicants point out that with respect to claim 23, Barney fails to teach or describe an amphiphilic polymer that is a "modified poly(acrylic acid) or modified poly(methacrylic acid), said modified poly(acrylic acid) or modified poly(methacrylic acid) including hydrophobic regions".

Accordingly, Applicants submit that claims 1-9, 17-23 and 25 are not anticipated by the teachings of Barney. Withdrawal of the rejection and allowance of these claims is urged.

Claims 11, 12, 26 and 27 stand rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Barney. The Office Action stated that Barney teaches colloidal nanocrystals, a solid composite including nanocrystals and a process of making a solid composite including nanocrystals comprising mixing nanocrystals-including ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, AlN, AlP, AlAs, AlSb, GaN, GaP, GaAs, GaSb, InN, InP, InAs, InSb, TlN, TlP, TlAs, TlSb, PbS, PbSe and PbTe nanocrystals-with a amphiphilic material-including alkyl phosphines, alkyl phosphine oxides, alkyl phosphonic acids, or alkyl phosphonic acids such as tri-n-octyl phosphine and tri-n-octyl lphosphine oxide or poly(laurylmethacrylate)-and a sol-gel precursor-such as silicon alkoxide, titanium alkoxide or zirconium alkoxide-and forming a solid matrix containing the nanocrystals at ratios of 5:1 to 10:1 of the nanocrystal solution to the binder such that the resulting composition has upwards of 80% high emission quantum efficiency as detailed above.

Since Barney teaches the same composition as claimed, one of ordinary skill in the art at the time the invention was made would have expected that the transparency of the sol-gel host and the uniformity of the distribution of the nanocrystals of the Barney composition would inherently be the same as claimed.

Where applicant claims a composition in terms of a function, property or characteristic and the composition of the prior art is the same as that of the claim but the function is not explicitly disclosed by the reference, the examiner may make a rejection under both 35 U.S.C. 102 and 103, "there is nothing inconsistent in concurrent rejections for obviousness under 35 U.S.C. 103 and for anticipation under 35 U.S.C. 102."

Applicants respectfully submit that claims 11, 12, 26 and 27 are each dependent claims on either claim 1 or claim 17. The Applicants have submitted remarks to explain how the presently claimed subject matter of claims 1 and 17 is patentable over Barney. Claims 11, 12, 26 and 27 are not being separately argued and will stand or fall together with the independent claim from which they depend.

Claims 10 and 24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Barney in view of US Patent Application Publication 2002/0155507 (Bruchez hereinafter). The Office Action stated that Barney teaches colloidal nanocrystals, a solid composite including nanocrystals and a process of making a solid composite including nanocrystals comprising mixing nanocrystals - including ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgS, HgSe, HgTe, AlN, AlP, AlAs, AlSb, GaN, GaP, GaAs, GaSb, InN, InP, InAs, InSb, TlN, TlP, TlAs, TlSb, PbS, PbSe and PbTe nanocrystals - with a amphiphilic material - including alkyl phosphines, alkyl phosphine oxides, alkyl phosphonic acids, or alkyl phosphonic acids such as tri-n-octyl phosphine and tri-n-octyl lphosphine oxide or poly(lauryl methacrylate) - and a sol-gel precursor-such as silicon alkoxide, titanium alkoxide or zirconium alkoxide - and forming a solid matrix containing the nanocrystals such that the resulting composition has upwards of 80% high emission quantum efficiency as detailed above.

The Office Action noted that Barney does not disclose expressly the use of octylamine-modified poly(acrylic acid) as an amphiphilic polymer. However, Bruchez discloses semi-conductor nanocrystals produced with partially grafted poly(acrylic acid) in which octylamines were attached to about 40% of the carboxyl groups of the poly(acrylic acid) (¶ 0287).

The Office Action concluded that at the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the octylamine-modified poly(acrylic acid) polymer of Bruchez in the compositions and processes of Barney. The motivation to do so would have been to produce a water-soluble semi-conductor nanocrystal composition (Bruchez ¶ 0287).

Applicants respectfully submit that Bruchez clearly spell out in paragraph 287 that the purpose of the "partially grafted poly(acrylic acid) (PAA), in which octylamines were attached to about 40% carboxyl groups of PAA through amide bond formation" was to lead to water-soluble SCNC's. The specifically claimed subject matter in independent claim 1 (from which rejected claim 10 depends) is for an "alcohol-soluble colloidal nanocrystal-polymer complex" between the colloidal nanocrystals with the amphiphilic polymer including both hydrophobic groups and hydrophilic groups. As an aside, please note that this is also the specific subject matter of presently withdrawn claims 13-16. Thus, while the specific language of claim 1 and withdrawn claims 13-16

regarding alcohol solubility is not present within independent claim 17 (from which rejected claim 24 depends), applicants submit that the "colloidal nanocrystals complexed with an amphiphilic polymer including both hydrophobic groups and hydrophilic groups" of claim 17 are indeed alcohol soluble as well. Thus, there is a sharp and distinct contrast between the teachings of Bruchez and the presently pending claims. Bruchez is addressing water solubility of their nanocrystals while the applicants are claiming alcohol solubility for their nanocrystals. As Barney does not disclose expressly the use of octylamine-modified poly(acrylic acid) as an amphiphilic polymer and Bruchez teaches only water soluble nanocrystals via use of octylamine-modified poly(acrylic acid), applicants submit that claims 10 and 24 are non-obvious over Barney in view of Bruchez. Withdrawal of the rejection and allowance of these claims is urged.

Lastly, Applicants submit that subject matter within the presently claimed invention has demonstrated unexpected results and such results have been noted by recent journal publications. Specifically, the present invention has yielded PbSe films that lase in the near-infrared region. Example 2 of the specification sets out that tunable amplified spontaneous emission (ASE) was obtained from a solid composite including PbSe nanocrystals that had been complexed with an amphiphilic polymer of an octylamine-modified poly(acrylic acid). In Chemical & Engineering News, vol. 81, no. 48, (2003) (copy attached) at page 7, the prior lack of success in this area was noted for achieving lasing in the near-IR region with nanocrystalline salts, such a result now achieved for the class of PbSe nanocrystals. The use of the amphiphilic polymer is noted and in the present claims, claims 6 and 22 are specifically directed to the species of PbSe. Later that month, Chemical & Engineering News, vol. 81, no. 51, (2003) (copy attached), set out at pages 37-50 the chemistry highlights of 2003. In their introductory paragraphs they described that in selecting the developments to be included they looked for studies having an identifiably superlative quality or element of uniqueness - such as the first time something was done, an order of magnitude improvement or a capability that was just not possible before. Applicants submit that subject matter of the presently claimed invention was identified in this article as being such a chemical highlight of 2003. Specifically, the article stated that "Victor I. Klimov and coworkers at Los Alamos National Laboratory showed that amplified spontaneous emission – an important step towards tunable IR lasers – can be achieved in the near-IR region using

nanocrystals of lead salts [*J. Phys. Chem. B*, published online Nov. 21, http://dx.doi.org/10.1021/ip0311660]". Applicants submit that these unexpected results presented in the specification and the accolades from the scientific community are additional evidence of non-obviousness. Applicants have submitted why neither Barney nor Bruchez anticipated the presently rejected claims.

In view of the foregoing remarks, claims 1-12 and 17-27 are urged to be allowable. If the Examiner believes there are any unresolved issues despite this amendment, the Examiner is urged to contact the applicants' attorney undersigned below for a telephonic interview to resolve any such issue. A favorable action is solicited.

Respectfully submitted,

Date: June 14, 2006

Bruce H Cottrell
Signature of Attorney

Reg. No. 30,620
Phone (505) 667-9168

Bruce H. Cottrell
Los Alamos National Laboratory
LC/IP, MS A187
Los Alamos, New Mexico 87545